AMATEUR WORK

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A SPECTROSCOPE.

A. ROTHWELL.

The high price of many of the required instruments prevents amateurs and students from purchasing them, and entering into the study of the natural sciences, much valuable knowledge and many a pleasant entertainment is lost to those who would, but for the above reason, gladly persue scientific studies. The spectroscope affords a means of examining the rays of light emitted from any source and determining their composition. Those who have not seen the beautiful prismatic band from white light will marvel at its beauty and purity of color, ranging from the red to the violet. It will well repay such to make the simple and inexpensive spectroscope here described.

Procure a piece of zinc, 14 or 16 guage, 12″ long and 3″ wide. Cut this into pieces to make a prism as shown in Fig. 1; that is, cut three pieces 3″ x 2 ½″. In two of these cut out a space in the centre 1 ¾″ x ¾″ as shown in Fig. 1. Solder the pieces together so that the base will form a true equilateral triangle, using a triangular piece of wood to assist in obtaining the correct shape. Then fit in the top and bottom triangular pieces, the top having a hole bored through and over this a threaded ¼″ nut is soldered. Fig. 1 shows the appearance of finished prism. Black the inside with thin glue to which a little lamp black has been added; this is to prevent reflections.

Take a piece of sandpaper upon a flat surface, and rub the sides of the prism containing the openings until they are flat, then rough up with the corner of a file, this is to give the glue a better opportunity to stick. Take two pieces of flat glass, 16 ounce English or German plate, free from scratches, and glue on the sides containing the openings. These pieces of glass should be $\frac{3}{16}$″ smaller all around than the sides of the prism. See that sufficient glue is put on to make a thorough contact, using care to keep the centre clean and free from glue. A little glycerine or molasses may be added to the glue to keep it from drying too brittle. Set away to dry, which will take about a week. When thoroughly dry, fill the inside of the prism nearly full with a solution of bisulphide of carbon, leaving an air space for expansion. Put in a machine screw, which has been covered with glue; allow it to set. As bisulphite of carbon has a very disagreeable odor and is very imflamable, the filling of the prism should be done in the open air and away from any flame.

This being done, take two mailing tubes from 1″ to 1 ½″ diameter according to diameter of lenses used, but of the size to telescope, one into the other. If they do not fit snugly, paper may be wound around the outside of the smaller one until it slides easily, yet must remain stationary where placed. The next requirement will be the end of the tube that carries the slot, as shown in Figs. 2 and 3; the former being a section on line *a a* in Fig. 3 which is a front view. A circular piece of wood ¼″ thick, with a hole cut through ⅝″ high and ⅜″ wide, is then glued inside the inner tube so as to be at right angles to the tube. Any cutting of the mailing tubes may be done with a fine jeweller's saw in a square mitre box. The ends can be smoothed with sandpaper, the tube being held in a vertical position. The other arrangement is made out of cigar box; Fig. 4, 5, and 6 shows the arrangement to better advantage

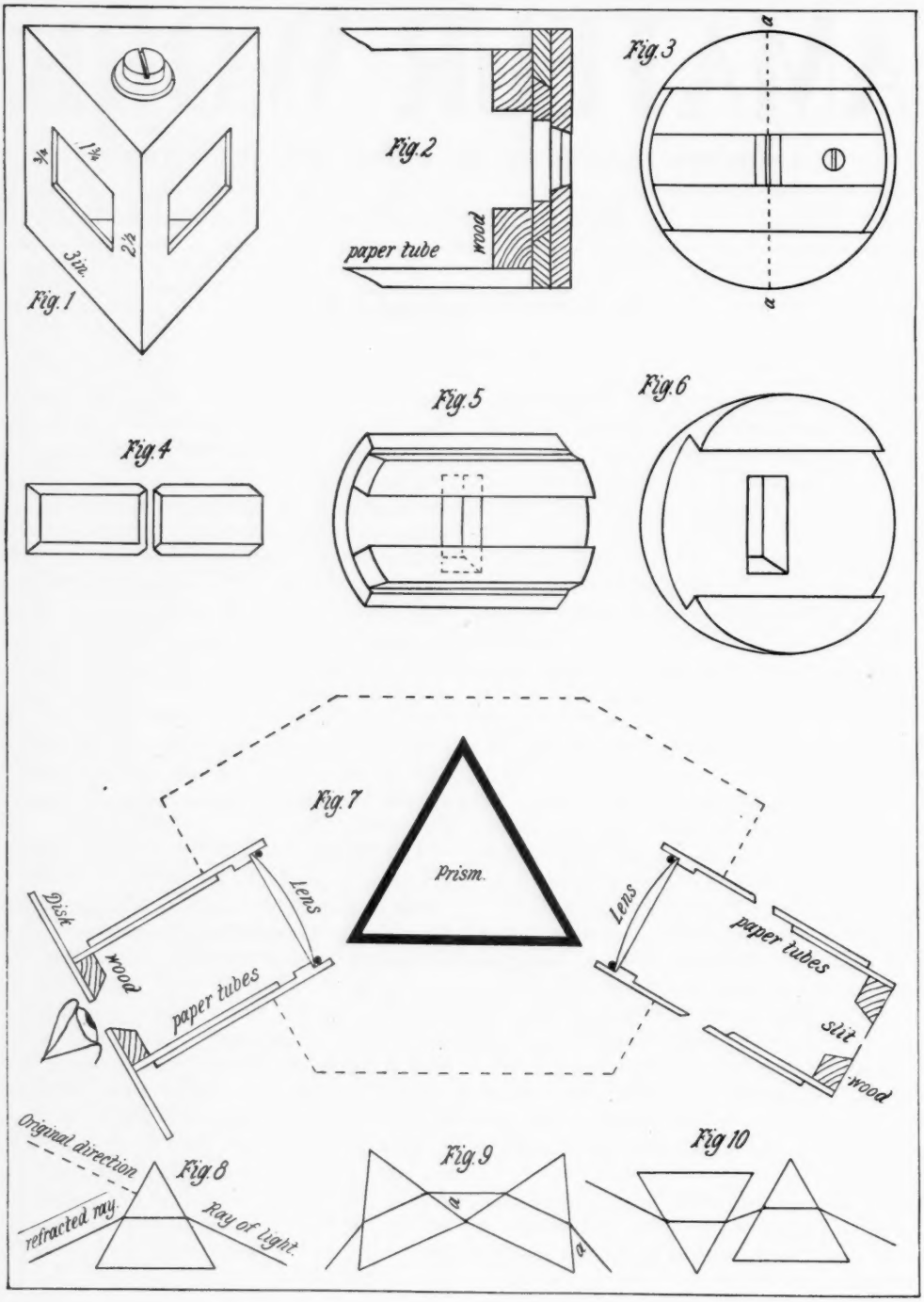

¾
1¾
3 in.
2½
Fig. 1
Fig. 2
paper tube
wood
Fig. 3
a
a
Fig. 4
Fig. 5
Fig. 6
Fig. 7
Prism.
Disk
wood
Lens
paper tubes
Lens
paper tubes
slit
wood
Original direction
refracted ray
Fig. 8
Ray of light
Fig. 9
a
a
Fig. 10

Fig. 4, being the slit goes into Fig. 5, and Fig. 5 into Fig. 6. Fig. 5, is made movable when desirable; either end of the spectrum may be brought into the centre of vision without disturbing the slit when once adjusted.

The slit proper, Fig. 4, should be made of brass or any other metal capable of receiving a high polish, the higher the polish the finer the result. The vertical joint should be perfect. One side of the slit should be made fast with a screw as shown in Fig. 3. Fig. 7 shows the arrangement of prism, lens and tubes. The lenses are held in position by gluing on the inside a piece of the mailing tube and using a piece of spring brass wire bent around the inner side of tube and pressed firmly against the lens. The eye tube is drawn about half scale, the collimator tube is shown broken, the length being determined by the focal length of lens used. The disk on eye tube is to shield the eye from outside light.

Having completed the necessary parts it now remains to place them in position, which can be done in a systematic manner avoiding all guess work. Take a flat board, on this draw two lines to equal 130°, providing the prism has been made equilateral. Let these lines represent the centre of the tubes, also of prism, on the horizontal or ground plane. Draw parallel lines equal to half the diameter of tubes. These will serve as guides for the outside of tubes; they are then blocked up until the centre of tubes corresponds with the centre of opening in the sides of prism, which may now be placed in position; the side having no opening should make an equal angle between the two tubes. This may be done by bi-secting the angle of 130° and drawing a number of parallel lines at right angles to the line of bi-section. These lines will serve as guides, should it be necessary to move the prism in adjustment. By using a little care there should be very little movement, the object being to bring the colored band in the centre of vision.

When everything has been adjusted satisfactorily, a box should be made out of $\frac{3}{8}''$ or $\frac{1}{2}''$ stock in form as indicated by dotted line in Fig. 7, two sides of the box being laid out at right angles to the tubes, and holes bored in position to take the tubes firmly, yet allowing them to be drawn out when necessary. When the final adjustment of prism is made, small strips of wood should be glued on inside of box to hold the prism in position. Make cover of box to fit to prevent any stray light from striking the prism. The inside of the box and tubes should now be painted a dead black to prevent reflections.

Fig. 8 shows a ray of light entering the prism, its original direction, and refraction. A single lens, or a compound eyepiece, may be used; if the latter, it will require two two-plane convex lenses of about 9″ focus. Should they be used singly the collimator tube which contains the slot should be of sufficient length to allow for telescoping to the focus of the single lens, 9″, and sufficient length remaining in the outer tube to hold firmly. If the eye is normal, the slot may be placed at its focus by measurement; however, if the slot is not sharp, the Fraunhofer lines will not show distinctly when the slot is adjusted to a fine hair line. Should the lines not be visible, then move the inner tube in and out until they are visible. Should horizontal lines appear, it indicates that the edges of the slot have not the requisite smoothness.

In using the compound form of eyepiece, each lens being of 9″ focal length, the distance they are to be placed apart is equal to two-thirds the focal length of either lens. If of unequal focal length, the distance they are to be placed apart is equal to one-third their sum. This compound arrangement shortens the focus, or makes the position of the slot much nearer to the lens, the position being obtained thus: — divide the product of their focal length by their sum, less the distance between them. This approximate position being found, a slight movement either way will suit the eye condition.

In making this simple spectroscope, it is not necessary that the conditions about lenses or size of prism should be exactly followed. Should one have an opera glass, the field lens can be used, either singly or in compound. If used in compound, then the distance between them must be obtained by the above rule, and a prism made in size to suit, or two glass prisms, such as are to be found in many schools, their arrangement being shown in Fig. 9 and 10, keeping the angles a, a, equal. The larger the surface of the prisms, the greater is the initial spread.

The Amateur lathe is very popular.

LANTERN SLIDE MAKING.

R. G. HARRIS.

III. Commercial Lantern Plates.

At the present time nearly the whole of the lantern slides produced by the vast army of lantern slide workers are made on commercial lantern plates. Their convenience and excellence have won for them an impregnable position in public favor, which is not yet without justification. The colors obtained upon the ordinary commercial plate range from an admirable black through browns to red, and even purple, should anyone have a taste for claret colored-lantern slides. The classification of colors obtainable on on a gelatine plate has been extended *ad uauseam*, and is often merely an individual statement of accidental results, the "rich sepia" of one man being the "warm brown" of another, the ingenuity shown in framing formulae to obtain these results having served to encumber the pages of photographic literature with a mass of recipes utterly bewildering to the uninitiated. The colors most generally useful are black, warm black, brown and warm brown.

To obtain any of these colors with certainity and to repeat the exact color obtained upon one occasion at any subsequent time is not easy, and the slide maker will find that he is forced more or less to compromise by accepting considerable departures from any standard color. Each worker, therefore, must adjust the developer to his own personal equation and method of working. The formula given in this chapter will be found to give the color described with tolerable exactitude, but as the worker in lantern slide operations progresses he will most certainly modify any formula that comes into his hands to suit his own requirements.

Before proceeding to a detailed account of the development of gelatine lantern plates, it may be well to mention that color in lantern slide work, more especially when made on gelatine plates, is almost entirely a matter of exposure followed by suitably adjusted development. Any reducing agent, hydrokinone, metol, eikonogen, etc. will give either warm or black colored slides if modified to suit the exposure. Short exposures in a strong light, followed by quick development, tend to the production of black colors, while long exposures, coupled with protracted development, result in colors more or less red. If therefore, the beginner bears this in mind, he will be able to make a rational application of any developer. In connection with this point, it may be interesting to give the results of some experiments made by H. Liesegang, and published in the *Photograqyic Cyronik.*

Color.	Proportionate exposure.	Concentration of developer.
Greenish black	1	1 to 5
Olive brown	2	1 to 5
Sepia	3	1 to 10
Brown	4	1 to 10
Red brown	6	1 to 20
Yellowish brown	8	1 to 20
Red	5	1 to 30
Reddish	10	1 to 30
Yellow	20	1 to 40

Although these results were derived from a series of experiments on the development of silver chloride, they agree very closely with what the lantern slide worker finds to be the case with gelatine lantern plates, which, in fact, are largely composed of silver chloride. The production of black colors in lantern slides calls for no special skill on the part of the worker; so long as he uses a clean, quick working developer and gives a short exposure, the rest is easy. In camera reduction, when working for black colors the light outside, if daylight methods are used, must be sufficiently good to give a well exposed plate with six to ten seconds exposure, and when "contact" exposures are made, the illuminant is better fitted for the production of black colors if it takes the form of an incandescent gas mantel. With such a light, and a negative of medium density held at a distance of about eighteen inches from it, the exposure need not exceed ten seconds. Any of the modern reducing agents will give black colors, but each one has a particular shade of black peculiar to itself. Thus, hydroquinone

gives a black that often assumes a greenish hue, especially with caustic alkalies; metol is characterized by its bluish black; and eikonogen has a very pleasing olive black. Amidol, in my opinion, gives the nearest approach to a pure black of any developer, though it is run very close by Edinol.

It will be seen from a consideration of the above peculiarities what a considerable undertaking it would be to give formula embracing all the recently introduced developers, with their varying shades of colors. I shall content myself with giving here several simple formulas, which are the sublimated results of many month's experiment among modern developers. Once the lanslide worker has passed through his apprenticeship, he will find the field of modern developers extensive enough to afford him many months' work, and the result will be sufficiently varied to suit the most exacting.

AMIDOL DEVELOPER (FOR BLACK.)

Amidol	20 grains
Sodium sulphite	240 grains
Potassium bromide	10 grains
Water	10 ounces

Development is very rapid, but it is necessary to give a seemingly excessive opacity to compensate for the loss of fixing. Any "forcing" of development through under exposure is to be carefully avoided in lantern slide work. The development should bring out the detail steadily through the various graduations, until the extreme highlights appear, and these should remain perfectly clear while the slide is acquiring sufficient opacity.

When development is judged complete, the slide is quickly placed, without any washing, in an acid fixing bath. It is a mistake to submit lantern slides to a washing process between development and fixing, as during the process the slide acquires sufficient density to cover the highest lights that have been so zealously guarded. I am aware that many hands have been uplifted against the use of an acid fixing bath, and probably will be continued to be raised until the end of the tale. My own experience is absolutely in its favor, and I have constantly employed it in the form given below for the last fourteen or fifteen years. For lantern slide work I particularly recommend its employment. Fading, marks of any and every description, have at various times been attributed to its employment, but in my fifteen years experience I have never found either a negative or lantern slide fade, and I see no reason, if properly made, for an acid fixing bath to cause fading.

The bath referred to is prepared by dissolving in ten ounces of water one ounce of sodium bisulphite; in another ten ounces of water four ounces of sodium hyposulphite are dissolved; and then, while stirring, the bisulphite solution is poured slowly into the soda solution. When mixed, the formula will stand thus:

Sodium hyposulphite	4 ounces
Sodium bisulphite	1 ounce
Water	20 ounces

On removing the slide from the fixing bath and examining it before a piece of opal or ground glass, it should appear "crisp" without any appearance of "inkiness" in the shadows, and when laid upon a sheet of white paper the extreme high lights should have the appearance of being bare glass.

AMIDOL DEVELOPER (FOR WARM BLACK).

Amidol	20 grains
Sodium sulphite	240 "
Ammonium carbonate	20 "
Potassium bromide	20 "
Water	10 ounces

The exposure for warm black colors when using the above developer will be about double the exposure required for black, and development will be rather slower; it should not be carried so far, however. When the production of warm colors is attempted with gelantine plates, it is better to adopt pyrogallol as the developer. Now that warm colors cannot be obtained with the modern reducing agents, but "pyro" and ammonia undoubtedly produce them with greater facility than do the others. The subjoined formula has given in my hands very good browns with above five times the exposure needful for blacks. With some plates, to produce brown colors, it may be necessary to add more bromide.

PYROGALLOL DEVELOPER (FOR BROWN.)

A.	Pyrogallol	30 grains
	Sodium sulphite	120 grains
	Citric acid	3 grains
	Water	10 ounces
B.	Ammonium bromide	40 grains
	Liquor ammonia (.880)	30 minims
	Water	10 ounces

Equal parts of each are taken to develop.

It will be noticed when developing for warm colors that the image develops in a manner differ-

ent from a black colored image. With black images the gradations appear crisply defined on the surface of the film, but with warm colored images the picture seems buried in the film, and is only seen when examining the plate by transmitted light. This appearance is rather puzzling to the novice, and misleads him into giving greater density to the plate than is desirable. Only experience can enable him to judge when correct opacity has been reached, but he will find, where warm colors are in question, that a very small amount of apparent density will prove on fixing to have been ample.

The development of lantern plates in the production of warm colors is oftentimes a tedious operation, requiring perhaps ten or fifteen minutes, and there seems no way of curtailing and retaining at the same time the quality of the image. Loss of time may be prevented by using a grooved tank and leaving the plates to develop while other exposures are being made. Development is so slow that over development need never be below 65° F. Should warmer colors than those given by the above developer be required, they may be obtained by adding to each ounce of the mixed developer twenty or thirty minims of a ten per cent solution of ammonium carbonate. It has been stated, but not on sufficiently good authority, that the use of carbonate causes fading. In place of adding the carbonate as a ten per cent solution, it may be combined with the developer in bulk, in which case the following formula is a convenient one:

PHROGALLOLL DEVELOPER (FOR WARM BROWN.)

A.	Pyrogallol	20 grains
	Ammonium bromide	20 "
	Sodium sulphite	120 "
	Sulphite acid	25 minims
	Water	10 ounces
B.	Liquid ammonia (.880)	100 minims
	Ammonium carbonate	20 grains
	Water	10 ounces

Equal parts of each are taken to develop.

The formula given in this chapter will cover the whole field of the development of gelatine lantern slides. Success in lantern slide work is due not so much to any special formula as to continued practice on the part of the operator. The production of first class slides as regards crispness, color, and exact density is not, in my experience, too easy of attainment, nor does there appear to be any "royal road" to such an end.

Photography.

PATTERN MAKING FOR AMATEURS.

F. W. PUTNAM.

Planes and Other Tools. – First Exercise.

The first requisite in the way of tools and appliances will be a carpenter's bench. Many readers will doubtless have a bench which will be entirely satisfactory for this work, and I will, therefore, only briefly outline directions for making a bench which can be readily taken apart at any time. For this bench the following pieces of stock will be required: — Three pieces of spruce 2″ x 5″ and 3′ long, as supports for the top, and two pine boards 12′ long, 12″ wide and 1″ thick for the sides. These side boards should be nailed firmly to the 2″ x 5″ cross pieces just mentioned. For the top use maple 1 ¼″ thick if procurable, otherwise clear white pine of the same thickness. This top is to be fastened firmly to the cross pieces, preferably with 2″ No. 12 wood screws. The legs are made from 2″ x 5″ spruce, the length of the legs depending upon the size of the workman. Fasten a piece of spruce 1″ x 3″ across each pair of legs, making a halved joint about 6″ from the bottom, placing the legs at the distance apart necessary for the width of the bench top. Cut a slit or opening in the top end of each leg, in order to straddle the cross piece at the ends, and put a 2 ½″ bolt 3 ¾″ long, through each leg and through the side boards, and the bench is complete. This can be taken down very quickly by simply removing the bolts from the legs.

A complete list of the tools necessary for the pattern work will not be given at this time, but a few hints on planes and chisels are desirable.

Later on, other tools and their application to the various patterns will be considered. The first operation to be understood by the pattern maker is the grinding of a chisel and a planer blade. If the reader will refer to the articles on "Wood Turning" and the portion dealing with the sharpening of turning tools, and if he will also read carefully the excellent article on "The Grindstone and its use" in the January, 1904, issue of AMATEUR WORK, this question will be found quite fully presented.

There are three common planes used by the pattern maker. The Jack Plane, Fig. 4, is used for removing the rough outside surface; the plane

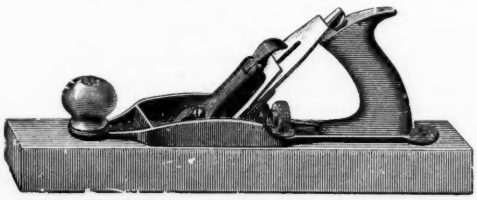


FIG. 4. JACK PLANE.

stock is generally made of beech, and the plane iron of cast steel. The blade cuts best when it is ground rounding at the corners, thus producing a slightly curved edge. This is the proper tool to use in removing a surplus of stock. The Smoother, Fig. 5, is an iron plane from 12″ to 14″ long, and is used for smoothing off the stock

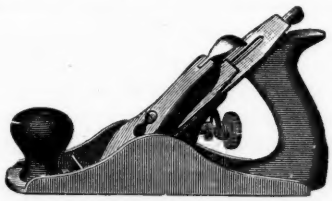


FIG. 5. SMOOTHER PLANE.

after being "roughed down" with the Jack plane. The blade is ground with a straight edge. The Block Plane, Fig. 6, is a short iron plane from 5″ to 7″ long, and is used for cutting across the end grain. The cutting iron is placed in the plane with the bevel on the top side.

Good planes can oftentimes be bought second hand, at a much lower price than new ones. A good *old* plane often works better than a new one, as the latter is quite apt to bother a novice, defying all his efforts to get it to plane a true surface. If second hand tools are to be bought, by all means enlist the aid of some friendly carpenter. The chisels and gouges had better be purchased new. To use a chisel successfully requires a great deal of experience. Two kinds of chisels are used by pattern makers, paring chisels

FIG. 6. BLOCK PLANE.

and firmer chisels. The former is used entirely by hand pressure, and the latter is used with a mallet. The paring chisel is much the longer of the two. A chisel should not be used both as a paring and firmer chisel, as the paring chisel must be kept with a very sharp edge. It is advisable to have several chisels running in width from $\frac{1}{8}$″ to 1 $\frac{1}{2}$″, the latter being the best width for the paring chisel.

FIG. 7. BEVEL EDGE CHISEL.

The grain of the wood must be thoroughly understood before one can pare smoothly with a chisel. To pare smoothly across the grain, hold the chisel edge at an angle to the fibres of the wood, the motion of the chisel being directly across the grain. In paring end grain the chisel should be given a motion across the end grain as well as a downward motion. Joints that are mortised or dovetailed, require a bevel edge chisel, as shown in Fig. 7. Chisels are sharpened in exactly the same manner as plane irons, but, being generally much narrower; they require special attention in the grinding so not to get a heavy feather or wire edge.

DRAFT.

Patterns should always have a little taper to the parts entering into the sand, in order to assist in their removal from the same, when their use will not be materially interfered with by such tapering. The pattern maker, therefore, works most of the thicknesses and the sides or edges, both internal

and external, a little out of parallel or square. When foundry patterns have their sides exactly parallel, the friction of the sand against their sides is great enough when they penetrate deeply, to require considerable force to extract them; the pulling of the pattern is very apt to tear down the sand unless the patterns are much knocked about in the mould to enlarge the space around them. This rough usage frequently injures the pattern, and causes the castings to become irregularly larger than intended, and also defective in shape. All these evils are much lessened when the patterns are tapered and made perfectly smooth. This tapering is called the *draft*, and for small patterns, a taper of $\frac{1}{8}''$ per foot is sufficient. The surface from which the draft runs is called the *face* of the pattern and is usually the upper surface of the mould, when the pattern is drawn.

SHRINKAGE.

An iron casting is always somewhat smaller than the mould in which it is made, and consequently smaller than the pattern. This is true of castings made from any of the common metals. Shrinkage of the metals when cooling, causes this difference in size. The amount of skrinkage will vary with the shape and size of the casting, and also with the kind of metal employed. The following allowances for shrinkage are made by pattern makers for ordinary purposes: —

Cast Iron, $\frac{1}{8}''$ to 12″. Aluminum, $\frac{1}{4}''$ to 12″.
Yellow Brass, $\frac{7}{32}''$ to 12″. Lead, $\frac{1}{4}''$ to 12.

FINISH.

If the surface of a casting is to be cut away or finished, an allowance equal to the amount removed is always added to the pattern, and is called an allowance for *Finish*. The allowance must always be great enough to allow for removing all scale and have the clean metal exposed. For ordinary small patterns $\frac{1}{16}''$ to $\frac{1}{8}''$ should be allowed, over and above the finished dimensions. As the size of the casting increases, the surface is liable to become rough and uneven, its irregularities and the total amount of shrinkage increase, and so a greater allowance for finish must be made. To avoid the necessity of making frequent calculations to determine the allowance for shrinkage and finish, pattern makers use a rule called a *Shrink Rule*. This rule is 24 $\frac{1}{4}''$ long, standard measure, and is divided in the same manner as the standard rule into inches and subdivisions of an inch.

RIBBED PLATE.

For our exercise we will make a pattern for a ribbed plate as shown in Fig. 8. The right end view of the plate is shown in section and indicates that two blocks are to be used for this pattern. The top surface of the pattern is marked *a* and the arrow indicates the direction in which the pattern is to be drawn from the mould. It will be noticed that the top surface is marked with an *f*. This is to be always understood as indicating that the surface upon which this mark is placed is to be finished in the machine shop.

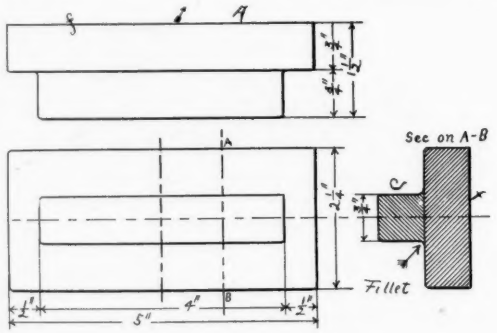


FIG. 8. RIBBED PLATE.

The dimensions in Fig. 8 indicate the size of the finished casting. If you have carefully studied the meaning of draft and finish, as applied to patterns, you will have no difficulty in making the necessary allowances. The planer blade can be set over from the centre so that the draft can easily be planed on the sides of the blocks. If you are without a block plane, a paring chisel or a wood rasp may be used on the ends. In any case, make sure that the taper is straight and in the right direction. If the taper is put in the wrong direction the pattern is said to have *back draft*, and if there is no taper there is said to be *absence of draft*. The tongue *C*, Fig. 8, is glued and nailed to the plate with four 1 $\frac{1}{4}''$ No. 16 wire brads.

GLUE.

Glue naturally suggests itself as an indispensible means of attachment. There is, however, a decided objection to its use in pattern work, as it does not stand contact with the damp sand. If the joint does hold, the glue will ooze out all

round, and will, unless carefully removed, cause a hard line of sand to stick to the pattern, thus spoiling what would otherwise be a good mould. Much depends on this glue in cases when patterns cannot be nailed or screwed, and it becomes absolutely necessary that only first class glue be employed. Among the many qualities of glue in the market are liquid, pulverized, and sheet glue. The liquid glue is good in quality and very handy for small light work, as it is always ready for use. The sheet or flake form dissolved and used hot is, however, preferred for general work.

Animal glue is generally considered the best, it comes in thin sheets and is the most expensive. As a rule, the best quality of glue is *amber* in color, and the flakes are quite thin. Glue should be soaked in cold water before placing it in the glue pot, but the soaking should never be continued for any great length of time, as this injuries the quality. Glue is strongest when freshly prepared and, if of good quality, can be drawn out into very fine threads. As a rule, the harder the glue, the better it will resist moisture. In gluing two pieces together, the glue must be thin enough to spread evenly; if the surfaces to be glued can be warmed, a much better joint may be obtained. Make sure that the surfaces to be glued are wiped clean of any dust before the glue is applied. This is especially true in the case of surfaces that have been sandpapered, for in this case the dust has probably been rubbed into the pores of the wood, and so closing them to the entrance of the glue.

When the end grain of wood is to be glued, give it a heavy sizing coat first. This is done to fill the openings among the fibres. When this sizing coat has become hard, the surfaces are given a second coat of glue and clamped together. If this is not done, the open end grain will probably absorb the glue so rapidly as to seriously weaken the joint. Plenty of time should be given the glue to set; in most cases, twelve hours in a dry place is sufficient.

FILLETS.

It will be noticed in Fig. 8, that at the joint between the blocks a sharp corner is avoided, and a rounded corner made instead. Sharp corners, whether inside or outside of a pattern, should be avoided, and whenever there is nothing to interfere, all corners should be slightly rounded. Sharp corners in a pattern will form sharp corners of sand when moulding, and these corners will give the moulder a great deal of trouble. Sharp corners, generally, not only detract greatly from the appearance of the pattern, but also injure its strength.

To overcome these difficulties, a *fillet* is generally placed at the sharp angle or corner, as indicated in Fig. 8. To form this fillet on the pattern for the ribbed plate, melt some beewax and run into the corner with a short piece of fairly large wire, say, $\frac{1}{8}''$ in diameter. When this wax is thoroughly hard, any excess may be scraped off and the surfaces lightly sandpapered. All wooden patterns require covering with some protective coating, to prevent warping and cracking from the influence of the moist sand in the mould, and also to prevent the glued joints from coming apart. This protective coating is not affected by moisture, and gives a smooth surface that draws easily from the sand. This will be taken up in the next chapter.

A MODEL STEAMBOAT.

CARL A. CLARK.

IV. The Boiler Fittings.

The next proceeding will be to fit up the boiler with steam gauge, safety valve, water glass, etc. It is recommended that the fittings be purchased of some of the dealers in such articles, as they are extremely fussy and difficult to make, and cost very little to buy.

The safety valve should be fitted in the position marked on sketch shown in the previous chapter, and should be set for 50 lbs. pressure per square inch. If screwed in, the hole in the boiler should be topped the correct size, and the valve screwed in tightly, after being smeared with red lead. The steam gauge is tapped in at any convenient place, in the steam space, preferabty somewhere on the front bead. There are frequently set on tube extension so as to be seen on deck. It should indicate up to 75 lbs. per sq. inch, that it may be used in testing. The water column is attached in the position shown by the two holes just above and below the water level. It must, of course, be brought out beyond the uptake, either in front or to one side.

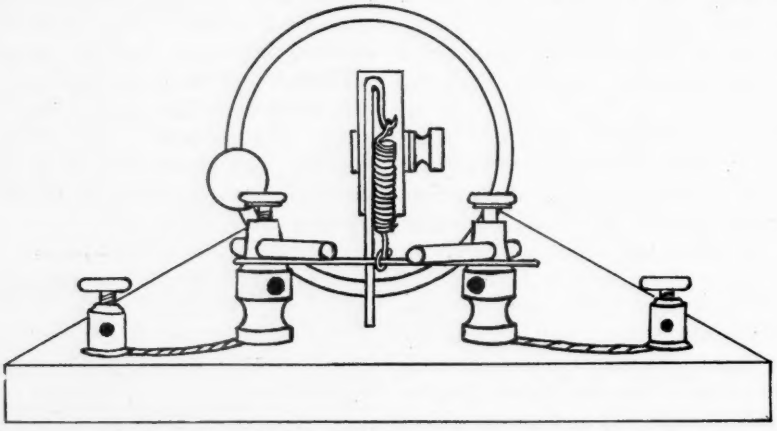
The feed pipe is attached at the small reenforcing piece just below the uptake. From the point marked "steam outlet" the steam is taken; a small valve is put on next to the boiler to regulate or cut off the supply of steam to the engine. The steam pipe is a brass or copper pipe about $\frac{1}{4}''$ diameter, bent to shape,

CONTINUED ON PAGE 165.

A WIRELESS TELEGRAPH RECEIVER.

S, W. LINDSAY.

Most wireless telegraph receivers are complicated, expensive and somewhat speculative, the results from them depending very materially upon one's skill and experience. Only a small percentage of the receivers produced by the more prominent wireless companies properly perform the service intended of them; but the instrument described below is simple, cheap and positive in its workings.



Mounted by means of tin straps on a base of wood, 6″ x 10 ½″ x 1″, is an ordinary dry battery, at each terminal or pole of which is a double screw binding post. Each of these binding posts carries a stick of carbon in its upper hole, about ⅛″ in diameter and 1 ½″ long, converging slightly. The lower hole of one post is connected with the carbon of the battery by a piece of neatly-coiled wire, leaving the zinc and the lower hole of the other binding-post free to make connection with the telephone receiver.

One and one-half inches from each of these binding posts and connected with them by a stout wire (which may be placed in a groove and is screwed down under the posts) is a single wood screw binding post. The screw on the telephone side is for the earth connection and the other is for the air wire, or atennae. The principle of the instrument is, as in other receivers, imperfect contact of conductors. In this instance it is formed by a highly polished piece of steel, such as a needle, resting against the carbons. There are two methods of supporting the needle. One is by a spring of light tension hung from a bent wire support as shown in the photograph. The spring can be made by turning brass wire around a pencil or small round stick. The other method is to bore a small hole in (but not through) each carbon, placed so that they point towards each other. Then between them the needle is fixed the ends resting in the holes mentioned. The needle thus makes a slight but firm contact.

When all are assembled the circuit is completed through the telephone receiver in which the signals are made audible as buzzes, the long ones being dashes, the short ones dots. Superior results can be obtained when the ocillation at the spark gap of the sending apparatus is very rapid, spreading waves in rapid succession. The reading of the signals, either in the American or Continental Morse Code, is simple, and with but little practice any one can take messages easily and accurately.

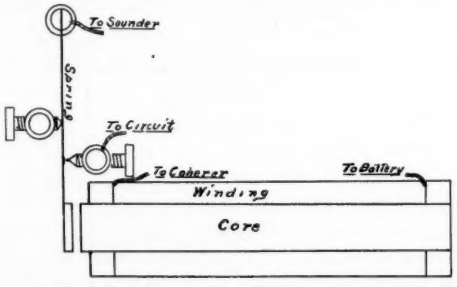
Compared with other receivers tested by the writer, the one described above is the most satisfactory because of its reliability and simplicity. Under conditions where all others would cease working and demand re-adjustment, it remained the same for days at a time. Beside, it admits of much handling, and works immediately upon being set up, catching the first signals clearly.

A SENSITIVE RELAY.

ARTHUR H. BELL.

The relay used in the coherer circuit of a wireless telegraph receiver must be of the highest sensibility. The resistance of the magnet windings should be at least 1000 ohms for experimental work at short distances, and upwards to 5000 for practical field work. With the higher relays, the armature will operate or "throw over" with one volt throughout 30,000 to 50,000 ohms resistance, and it is this extreme sensibility which commends it to wireless specialists.

To the amateur who wishes to progress as far as possible in his researches with a limited expenditure of money, the cost of these relays would at first seem prohibitive, but it is the purpose of this article to explain the construction of a relay which is giving good satisfaction and which was completed for a reasonably small sum. The manner in which this relay operates reminds one of the vibrating attachment to a simple induction coil.



The electro-magnet consists of two square pieces of wood, 1 ½″ x 1 ½″ x ⅜″ thick, each having a ¾″ hole through the centre. A bundle of fine annealed iron wires as fine as No. 24, or still finer if possible, 6″ long and ¾″ in diameter is next procured, and one of the wooden squares glued securely on at each end, the iron core projecting outward a half inch at one end. This core is evenly wound with the finest magnet wire at one's command. The writer used No. 36 for a greater portion, and No. 34 to finish winding to the full capacity of the bobbin, having the same on hand, but it is best to use only one size, No. 36. It will be found that a weak cell of dry battery, not strong enough to ring a vibrating bell, will energize this core sufficient to attract iron filings through quite an air space. When completed the magnet is glued or screwed down to a base board of smooth wood about 4″ x 8″.

There is a kind of ribbon steel, similar to clock spring stock, which may be purchased of clock repairers, in small lengths. This is remarkably flexible, and should be procured in a perfectly straight strip 4″ long and about ¼″ to ⅜″ wide. This is to form the spring for the armature. At one end is soldered the armature, a soft iron disc about ⅛″ thick and ¾″ diameter. The other end is fastened to a small upright pillar post, placed in such a location on the base board that the iron disc is just opposite the magnet core, and ⅛″ away from it. It will be found that this armature will respond to a very feeble current passed through the coil. The contacts are similar to those on an induction coil, only of course, the contact screw is on the other side of the vibrator, and touches to make contact only when the magnet is energized. It is a good idea to mount an adjustment screw to press on the outside of the spring vibrator, so as to closely adjust it in relation to the magnet and the contact screw. The contact on the contact screw must be a platinum point, and on the spring vibrator a little point of platinum is also necessary, for a perfect electrical contact is very essential.

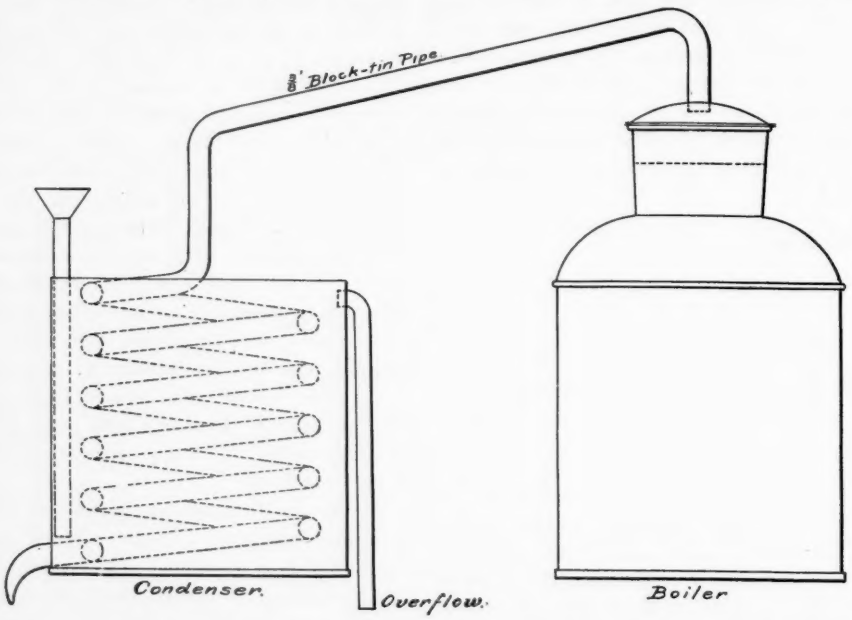
There are four binding posts, two for the coil terminals and two for the relayed side. One binding post is connected to the vibrator and the other to the pillar contact post. In the construction of a relay as here described, the making of pivots and other difficult parts is avoided. It will also suggest other types, perhaps better adapted to the experimenter's particular requirements, as the study of wireless telegraphy is continued.

The gasoline engine is rapidly replacing steam as a motive power for automobiles and launches, as shown by recent exhibitions of same.

A STILL FOR WATER.

R. G. GRISWOLD.

Distilled water is being used for so many purposes, especially in the dark room, that every worker in this line should have a still with which he may provide himself with a liberal quantity of pure water. The following description tells how to make a very cheap but efficient still. It may be operated in any manner that best suits the convenience of the operator, and if placed on the rear of a stove will work continuously all day without much attention, and with no cost of fuel as the cook stove generally runs for the entire day, whether meals are being cooked or not.



Make the boiler out of a common milk can that has a taper-fitted lid or stopper. Melt the handle off the lid and punch a hole in the centre large enough to admit the end of a ⅜" block tin pipe. In soldering this pipe in place great care will have to be exercised as the tin pipe will readily melt with a hot soldering iron. A piece of wet cotton put inside the tube at the point of soldering will sometimes prevent this accident. The taper of the lid will generally shut the boiler tight enough as the steam pressure is very low, but if too much escapes, slip a rubber band around the lower end of the taper and then insert in the neck. This will make a steam tight gasket.

The condenser may be made from a large size tomato can that has had the ragged edge melted off. Two ¼" brass tubes are soldered to its sides, one for the inlet through which the cooling water is poured and the other an outlet which carries away the hot water from the top to a pail or other receptable on the floor.

The condensing worm is made of ⅜" block tin pipe, such as druggists use in their soda fountains, as this does not dissolve in the condensing water; neither does it corrode. About four feet will be amply sufficient and it may be rolled around an ordinary bottle to give it the coil shape. The end is passed through a hole in the bottom of the can and soldered there. If the end is nicely shaved off to make a lip as shown, the water will drop off and into a receptable without spattering or running around the end of the tube.

Of course it would be better, to make the cans of copper, tin lined as they would never rust, which the tin will quickly do. This rust, however, has no effect upon the purity of the water as none of it passes over, and the cans are so cheap that they may be readily replaced when rusted through. The supply of cooling water may be supplied through a small rubber tube from a bucket overhead, using a small tube as a siphon. This still will be found very efficient, and with an ordinary Bunsen burner under the boiler will give about two gallons of water per day.

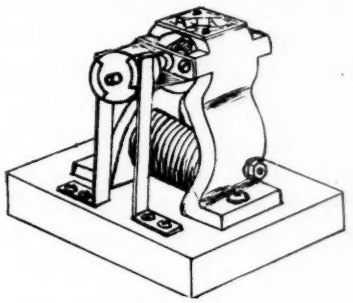
A ROTARY INTERRUPTER.

The following is a description of a rotary interrupter which, when neatly constructed, should give higher frequency results than may be obtained with the ordinary type of vibrator. The first requisite is a small but well made electric motor, of a type similar to those sold by electrical supply dealers for toys. It may be necessary to remount the motor on a larger base. With two or three cells of battery, the motor should develop from one to two thousand revolutions per minute even when some friction is applied to the shaft.

Procure a piece of extra heavy brass tubing, 1″ in diameter, and ¾″ long. Smooth both edges, and solder securely to one end a disc of sheet brass of same diameter as the outside diameter of the tube. This will now resemble a cover to a small round metal box. Find the centre of this disc and mark off into four equal parts. With a knife blade, file or jeweller's hack saw, cut four slots in the surface of the cylinder, as if making four segments for a commutator. Then remove two opposite segments of the tube, using great care not to weaken the joints of the two remaining segments. On a piece of whitewood or pine, ¾″ thick, place the end of the brass tube, and sketch thereon the outline of a plug which shall be a tight fit for, and at the same time comform to, the cylindrical contour of the tube. This plug should be secured in place with brass brads or very small brass screws. Measure the diameter of the motor shaft and drill a hole through the plug so it will fit on the shaft like a pulley. Perhaps an easier way to make the plug would be to find a spool of the right size and file slots in it for the brass tube.

There are to be two brushes, one directly opposite the other. These may be of fine copper or brass gauze, or thin spring brass. These are bent to an L shape, the bend at the lower end being attached to the base board with two round head brass screws, one serving for connection with coil.

Connect one terminal of the coil battery to one brush and the other brush to one terminal of the primary winding, and the second terminal of the primary to the other terminal of the battery. A separate set of batteries is used to drive the motor. It will be seen that every revolution of this "commutator" means two interruptions of the current because, when the brushes rest on the brass segments, a circuit is established, and when on the wood the circuit is broken. After experimenting for a time with this interrupter, the amateur may make a cylinder with more segments, which will of course increase the frequency.



In an induction coil, the instantaneous values of the secondary are proportional to the product of the ratio of transformation and the instantaneous pressure upon the primary (disregarding iron losses in the core.) To secure the greatest efficiency, the primary current should be broken as soon as it reaches its maximum value. And when the break occurs, it must be quick and "clean cut" as it were, so as to give the highest voltage in the secondary. It will, therefore, be seen that the above described "commutator interrupter" can be changed and improved somewhat in the design of the segments, by making them wider with less space between so as to give a greater period of time in the "make" and less in the "break" but it would be a good idea to first make one as described, and from it become acquainted with its action.

Renew your subscription promptly.

AMATEUR WORK

77 KILBY ST., BOSTON

DRAPER PUBLISHING CO., PUBLISHERS.

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month for the benefit and instructio, of the amateur worker.

Subscription Rates for the United States, Canada and Mexico $1.00 per year. Single copies of any number in current volume, 10 cents.

TO ADVERTISERS.

New advertisements, or changes, intended for a particular issue, should reach the office on or before the 15th of the previous month.

Entered at the Post-office, Boston, as second-class mail matter Jan. 14, 1902.

APRIL. 1904.

Several very interesting articles as well as "Correspondence" are omitted from this issue, owing to lack of space. They will appear in the next issue, and at an early date the magazine will again be enlarged several pages. We know that our many readers await the successive numbers with much interest, and we, on our part, are earnestly striving to provide as much and as valuable reading as possible; feeling sure that our efforts are thoroughly appreciated.

We have received a number of letters asking for particulars about excursions to the St. Louis Fair. As quite a number of our subscribers have expressed their intention to attend, the idea of an "Amateurs" excursion has been suggested, and in that connection would be pleased to receive suggestions from our readers. The cost including all expenses, except meals enroute, would be about $60, with one week at the Fair. The most suitable time would probably be late in July or early in August.

Cloth covers for binding volume II, AMATEUR WORK, uniform with the previous volume, will be mailed, postage paid, for 25 cents. With these covers the magazine can be taken to the nearest bindery and bound for a small sum.

BOOKS RECEIVED.

COMPENDIUM OF DRAWING. Various authors. Two volumes, 410 and 477 pp., 9 ¾ x 6 ¾. $5.00 or $3.00 for single volume. American School of Correspondence, Chicago, Ill.

As might be expected of any book made up of writings by several authors upon different kinds of work, there is a lack of even and progressive treatment of the subjects, but even with this disadvantage, the scope of the two volumes is so wide and the several parts so excellently and comprehensively presented, that one can easily overlook minor matters. As desk books for teachers of manual training, they would be of special value. To mechanics or others who find it desirrble to have a working knowledge of the leading branches of drawing, these books would be invaluable. In fact, they are probably the most liberal value for the price of any books to be had upon this subject. Space does not permit of detail mention of the eight branches of work covered. The illustrations are numerous and well done.

LESSONS IN PPYSICS. Lothrop D. Higgins, Cloth. 379 pp. 7 ½ x 5. 90 cents. Ginn & Co., Boston.

A course in Physics without laboratory work is very much like "Hamlet" without the chief actor, nevertheless, it is an unfortunate fact that numerous schools in this country are well nigh destitute of even the simplest apparatus for experimental work, and instruction in this most important study must be dependent, therefore, solely on what can be given with the aid of a text book. For such schools, this book is particularly well adapted, as principles are explained by references to common or familiar phenomena, the physical manifestations most commonly met in our daily life being used as illustrations wherever possible. The author has also used care in the selection of words, technical words being defined, and a glossary gives further explanations. The illustrations number 233.

MECHANICS, MOLECULAR PHYSICS AND HEAT. Robert Andrews Millikan. 244 pp. 8 ¼ x 5 ¼. $1.50. Ginn & Co., Boston.

The close relation which should exist between classroom and laboratory is clearly appreciated by the author, who presents in this combined text-book and laboratory manual, a twelve weeks college course in which *principles* are thoroughly and logically presented, and the laboratory work arranged in close accord therewith. An especial effort has also been made to present Physics as "a science of exact measurement." The latter feature necessitates carefully designed and well made special apparatus, which should, however, be within the means and form a part of the equipment of the colleges which would find this book suitable for use. The central idea has been to present a course in compact form which would teach thoroughly a few fundamental principles, and in this, has been particularly successful. Fifteen tables and 126 illustrations

CONTINUED ON PAGE 168.

SAILING RULES FOR LAUNCHES.

CARL H. CLARK.

I. Conduct of Launches when under way.

In order to avoid collision it is necessary that vessels approaching each other, especially in crowded thoroughfares, should have some preconcerted and well understood rules and signals to signify their intentions. For this reason the "Pilot laws" have been enacted by the Government. Although these do not apply strictly to small launches, and are not always regarded by the amateur pilot, every launch owner or person running a launch should have a knowledge of them, and should accustom himself to following them as closely as circumstances will allow.

All power vessels are supposed to be equipped with whistle and running lights, and on the larger boats which are registered, these are compulsory. Small launches, which are easily handled, may be kept clear of other craft and avoid all chance of damage, but larger boats, in crowded places should by all means closely observe the following rules:–

FIG 1

I. Boats approaching each other, head on, should each keep to the starboard (right) and pass on the port (left) side of the other, at the same time giving a single blast of the whistle which the other must answer. It is not allowable to keep on until receiving the answering signal, showing that the other has understood. This position is shown in Fig, 1.

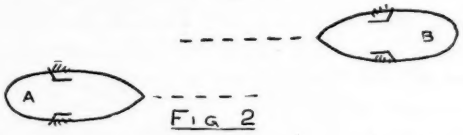


FIG 2

II. When the courses of the two are so far to starboard that there can be no uncertainty, as in Fig. 2, no signals are necessary.

III. When, as in Fig. 3, the courses of the two are to the port of each other, and to pass to starboard would mean a radical change of course, each boat keeps to the left of the other passing on the starboard side, at the same time blowing the whistle twice, which shall be answered by the other.

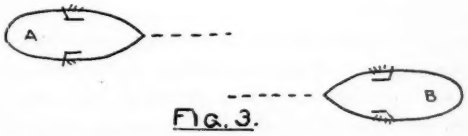


FIG. 3.

IV. When boats are approaching, as in Fig. 4, in an oblique direction, the one which has the other on her starboard side must keep out of the way of the latter, by changing her course so as to

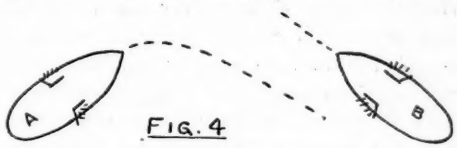


FIG. 4

pass astern the other and blowing the whistle once. As shown, *A* must pass astern of *B*; *B* must hold her course and speed.

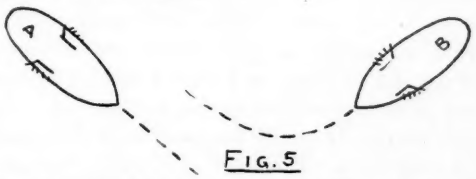


FIG. 5

V. Approaching, as shown in Fig, 5, *B* must give way to *A*, changing her course to starboard so as to leave *A* on the port side, at the same time blowing the whistle once, which must be answered by *B*.

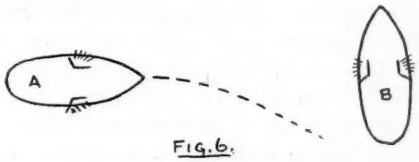


FIG. 6.

When one boat is overtaking another, as in Fig. 6, the overtaking boat may change her course so as to pass to the starboard of the other, after blowing one whistle and receiving the reply.

She may change her course so as to pass to port, by giving two blasts and receiving the same reply. The overtaken boat, as in Fig. 7, may show her disapproval of the course taken by the other by blowing several short whistles, but must not

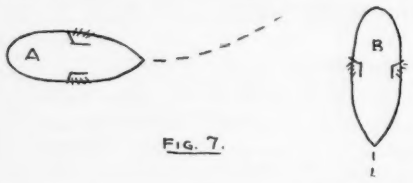


FIG. 7.

change her course so as to endanger the overtaking boat. The overtaking boat must keep clear of the other. When on any course, a power boat and sailing yacht are approaching each other the power boat must keep clear.

A boat, in getting out of another boat's way, should not do so by crossing her bow, but by going under her stern. The fact of one boat having the right of way over another does not permit her to do damage to the other, and each must do her best to keep clear. It must be borne in mind, also, that these rules apply to vessels of somewhere near the same size; with a launch, for instance, it would be unwise to attempt to enforce her right of way over a steamer or large towboat. The launch, being of light draft, can be more easily kept clear, and should do so in all cases. These rules are simply for guidance and do not give a boat, even when she has the right of way, an excuse for doing damage to an offending boat or forcing her ashore.

In sailing at night the same rules hold good. The relative positions of the boats, however, are determined from the lights which each is by law bound to carry. These lights consists of a white light, a red light on the port side and a green light on the starboard side. The two latter are to be fitted with screens arranged in such a manner that the red light can be seen from all positions between right ahead, and two points aft of a beam on the port side, and the green from all points between right ahead and two points aft of abeam on the starboard side. The red must not be visible from the starboard side, nor the green from the port side. The white light is supposed to be visible from all positions.

Small open launches, under 10 tons register and propelled by gas, naptha, or electric motors, may show a combined lantern containing all three together.

I. Referring to Fig. 1, it is evident that each will see both lights of the other, and each will keep to the starboard, after giving one whistle.

II. In Fig. 2, each will see the red light of the other and may keep their courses after giving one whistle.

III. In Fig. 3, only the green lights of each will be visible, and all boats should keep to port, passing on the starboard side of each other after giving two whistles.

IV. In the position shown in Fig. 4, *A* sees the red light of *B* and *B* sees the green light of *A*. The courses are converging, and *A* should change his course and pass under *B*'s stern while *B* continues his course, each having given one whistle.

V. In Fig. 5 the red light of *A* is seen by *B* and *B*'s green light is visible to *A*. In this case *B* should pass under *A*'s stern and *A* should keep his course, each having whistled once. These two situations are somewhat uncertain and require care if the boats are near each other, as it is difficult to tell just how fast they are converging.

VI. In Fig. 6, *B* will see both lights of *A*, thus indicating that *A* is coming head on to *B*, while *A* will only see *B*'s red light, thus indicating to her that *B* is crossing her bow with her port side toward *A*. *A* will then change her course to pass under *B*'s stern, while *B* keeps course without change.

VII. In Fig. 7, *B* will see both lights of *A* and know that *A* is approaching him head on, while *A* will see only the green light of *B* and know that *B* is crossing his bow with her starboard side toward *A*. *A* will then change her course and pass under *B*'s stern, *B* keeping her course. When one boat can see neither red nor green light, the white light is still visible, and there is no risk of collision except by lack of care on the part of one boat overtaking another, in which case care must be used.

A boat at anchor must show a single white light. A boat is considered to be under way unless she is actually anchored, made fast to the shore or grounded. In fog or mist speed should be low and a sharp lookout kept, and the whistle or fog horn continually sounded. As before mentioned, these rules are for general guidance

in avoiding collision, and do not give the vessel or boat having the right of way the right to cause a collision.

The safest procedure for a small launch is to keep out of the way of all larger craft, and thus avoid as, far as possible, all chance of collision, especially when not carrying lights. On the water, as in no other place, strict care and watchfulness are necessary, especially in night sailing. It is unfortunately very seldom that small launches will take the trouble to carry lights; only by keeping strict watch is collision avoided.

A PLANT STAND OR TABORET.

FRANCIS L. BAIN.

The tabourette about to be described may be made of either whitewood, basswood, or any dark colored hard wood, such as walnut or mahogany. If whitewood is used it may be stained in imitation of nearly any hard wood, while if basswood is used, an opportunity is presented for doing a little pyrography.

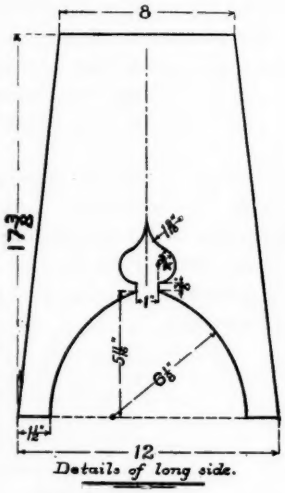


Fig. 1.

Fig. 2.

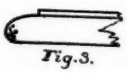
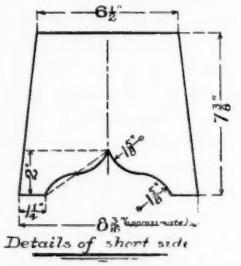
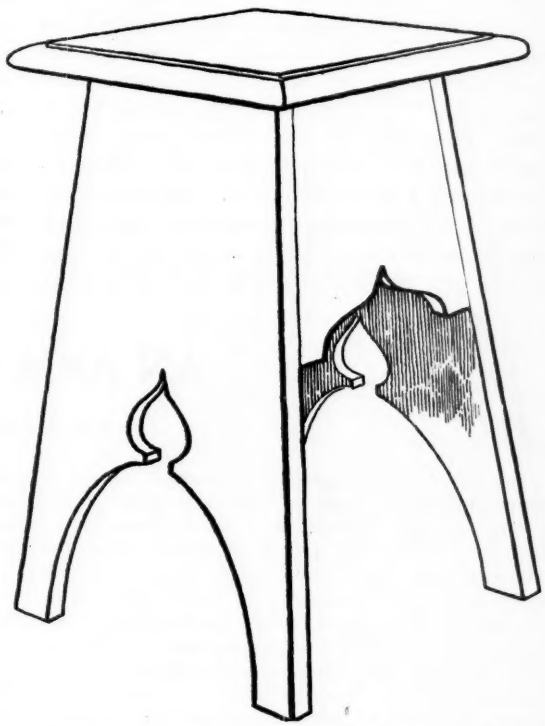


Fig. 3.





About six feet of ⅞" stock, 13" wide, will be required, and it should be thoroughly dry, as well as free from knots or checks of any kind. Well dried stock is always preferable, but especially so when the different pieces are very wide in the finished article. If it is not possible to get the stock 13" wide, use 7" instead, gluing two pieces together to obtain the required width. As the thickness of the five pieces which make the stand is the same (¾") it is perhaps as well to plane the six feet of stock to that size before laying out any details. Cut the board into five pieces, as follows;—2 pieces 18" long, 2 pieces 8" long, 1 piece 13" long. The 18" pieces are for the two long sides of the stand, and should be laid out very accurately and carefully according to

the figures in the detailed view of the long side.

It will be seen that an expansion bit can be used to cut out that portion of the upper part of the design where a radius of $\frac{3}{4}''$ is designated. This method should always be used when possible, as it is often difficult to cut out very small curves, and an expansion bit with the usual two cutters will answer for all holes from $\frac{1}{2}''$ to $3''$ in diameter. The balance of the curves may next be sawed out with either a keyhole saw or pad saw, and carefully smoothed with Nos. 1 $\frac{1}{2}$ and 0 sandpaper, a half round file first being used, if necessary. Then the sides and ends should be planed to the proper size and shape.

The two short sides should next be laid out, and finished to the proper size and shape, in practically the same manner as were the long sides, except that the expansion bit is not used. The top is to be made next, the dimensions being $12'' \times 12'' \times \frac{3}{4}''$. After planing to the proper size, a line should be drawn on the upper side $\frac{3}{4}''$ from and parallel with each edge. Another line should be drawn on the edges $\frac{1}{8}''$ down from and parallel with the top side. These measurements are clearly marked on the corner view in Fig. 1. These lines should then be "scored" with a sharp knife, and the corner, $\frac{3}{4}''$ wide by $\frac{1}{8}''$ deep, removed with a chisel and mallet. The square corners of the projecting lip should be beveled off slightly around as shown in Fig. 2, and the edge should then be finished to the shape as shown in Fig. 3, a plane and sandpaper being used to accomplished this and a flat file if necessary.

The sides and top are attached to each other and held firmly in place by means of corner blocks screwed to the inner face of each side and the top by means of 1 $\frac{1}{4}''$ No. 9 wood screws. Four of these pieces should be made of pine or whitewood, the finished size being $7\ \frac{1}{4}'' \times \frac{3}{4}'' \times \frac{3}{4}''$, two being screwed to the inner surface of each of the short sides, just flush with the lengthwise edges. The four sides should then be clamped firmly together in their proper position, and while in the clamps screws should be driven through the corner pieces into the long sides, thus securely attaching the sides together. Now cut out four more corner blocks similar to the first set, which shall finish $5'' \times \frac{3}{4}'' \times \frac{3}{4}''$ and screw these to the inner faces of the four sides, exactly flush with the top. Then having first drawn an $8''$ square in the centre of the underneath side of the top to show its proper position when in place, turn the stand upside down with the top resting upon the bench and screw through the corner blocks into the top, thus fastening the whole stand firmly together.

It will now be necessary to give the stand a thorough cleaning with fine sandpaper, after which it may be decorated with pyrography, or stained according to the stocks elected at first. This stand is especially intended for large, heavy plants such as palms, ferns, etc.

AN ARM CHAIR.

JOHN P. ARTHUR.

Antique or colonial furniture, at present so much in vogue, has many characteristics that appeal to the average person, especially as it can be made by the amateur who may have a taste for wood-working and possesses a moderate outfit of tools. There is, to such a person, a certain satisfaction in being able to show to a visitor, some piece of useful or ornamental furniture, accompanied with the statement that "I made it".

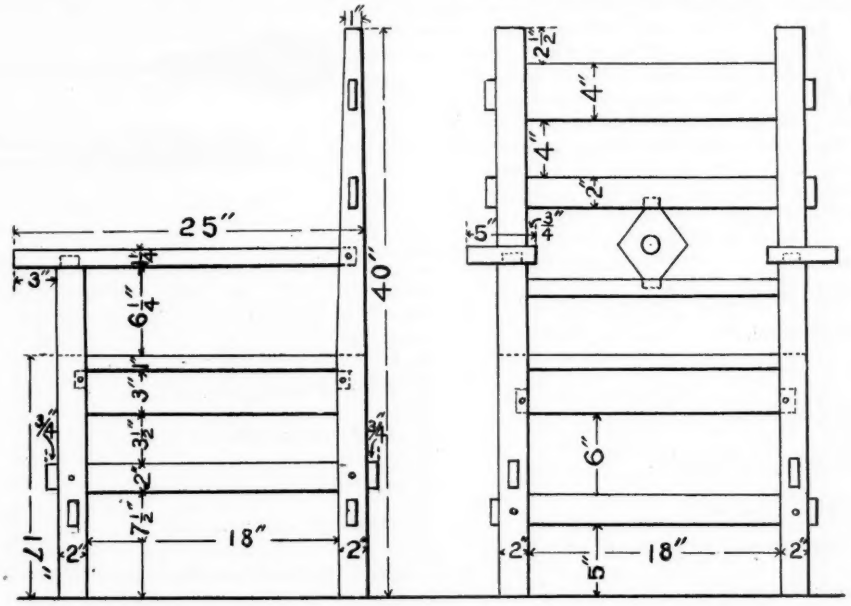
The arm chair here described is not difficult to make, is strong without being too heavy to easily move about. It should be made of straight grained white oak, which takes the much desired "dull finish" nicely, and does not easily chip or crack. Birch or maple can be used if oak is not easily obtained. In any case, the wood should be thoroughly seasoned. All joints should be mortised, glued and pinned. Finish the several pieces to a smooth surface with a wood scraper, then sandpaper thoroughly, using about No. 1 $\frac{1}{2}$ first and finishing with No. 0. If a black finish is desired, stain with black asphaltum thinned with turpentine. After this sets (not hardens) rub down with powdered pumice stone and raw linseed oil. When thoroughly dry, apply another coat of asphaltum and oil, and rub down as before, continuing until the desired depth of color is obtained. A coat of varnish can then be added or not, according as a bright or dull finish is desired.

The legs are made of pieces $2'' \times 2''$, the front ones being $24''$ long, and the rear ones $40''$ long. The top ends of the front ones are cut in $\frac{1}{4}''$ on each side and

$\frac{3}{4}$″ from the end, leaving the ends 1 $\frac{1}{2}$″ square, fitting a mortise of same size cut in the under side of the front ends of the arms. The rear legs are tapered on the front sides from a point 17″ from the lower ends to the top, where they are 1″ thick, as shown in the side view. The rest of the chair is made from 1″ stock, though the arms would looks better if made 1 $\frac{1}{4}$ thick. The cross pieces of the seat frame are 21″ long and 3″ wide. They are mortised into the legs flush to the outside, making the seat 22″ square, with 2″ squares cut out at the corners to allow for legs. This gives seat frame a sort of panel effect, as the seat projects over the frame 1″ and is flush with the outside of the legs. The tenons on the cross pieces are cut only half the width, those on the side being on the lower half, and on front and back pieces on upper half, thus allowing them to pass by or cross each other in the mortises in legs, which are cut to receive them as stated.

The four cross pieces on the lower part of the chair have long tenons passing clear through mortises cut for them in the legs, the ends projecting $\frac{3}{4}$″ on outside. These pieces are 23 $\frac{1}{2}$″ long and 2″ wide. Those on the front and back are 5″ from floor, the two side pieces, 7 $\frac{1}{2}$″ from floor, allowing the mortises to be clear of each other with $\frac{1}{2}$″ of wood between. These tenons are cut $\frac{1}{2}$″ thick, giving on 1″ stock a $\frac{1}{4}$″ shoulder. The four cross pieces forming the back are 4″, 2″ and 1″ wide, as shown in front view. The two top pieces are mortised through the rear legs, and are 24″ long. The lower piece is 20″ long with 1″ tenons at each end. The diamond at back is made of $\frac{1}{2}$″ stock, is 4″ wide, and mortised with $\frac{1}{2}$″ tenons to cross pieces above and below. The seat is fastened to frame with strips 1″ square screwed and glued to seat frame and seat with 1 $\frac{1}{2}$″ wood screws.

The arms are 5″ wide at the front, cut down to 2″ wide at the back, with a rounding curve. They are 24″ long, with $\frac{3}{4}$″ tenons at the back, fitting mortises cut in rear legs. Both ends are glued and pinned. If care is used in making the tenons and mortises, a strongly built and servicable chair will result.



The power of a steam engine should not exceed requirements if economy is to be studied. "Power" says that in reading accounts of steam engines one constantly finds statements that the engines supplied by a certain firm are capable of an overload of, it may be, 20 or 30 per cent. But if an engine rated at 100 H. P. will actually work at 130 H. P. with equal economy, it is clear that the engine has been wrongly rated. The value of a machine depends upon its economy, efficiency, and durability, and there is no worse fault than that exemplified in the phrase "making it big enough," meaning usually too big. Many a steam engine if smaller would do its work with better economy. Sometimes a man gets hold of an engine which is in first cost really cheap, being perhaps half the price of an engine of half the power; but it is really dear to him, for it is losing heat in excessive radiation, and wastes every year more in coal than was saved in the first cost.

The world's consumption of emery is 25,000 tons annually, of which Asia Minor supplies some 18,000 tons, valued at $250,000; Canada, 388 tons, valued at $50,000; and Naxos, 6,328 tons, valued at $130,000.

PRINTING FOR BEGINNERS.

FREDERICK A. DRAPER.

VI. Correcting Proof. — Proof-reader's Marks.

In the previous chapter, the method of taking proofs was given. As it rarely happens that the composition is without errors of some kind, we will now consider the way to indicate and correct them. Certain signs are used to indicate the different kinds of errors, so that the compositor may know just the correction to be made. They are given, with their explanations in the following list, and by comparing them with the uncorrected and corrected examples, can quickly be committed to memory.

BODKIN AND TWEEZERS.

PROOFREADER'S MARKS.

⊥	Space standing too high, push down.
#	Insert space.
⌣	Less space.
V	Even spacing.
⁀	Close up space entirely.
X	Change a bad letter.
ꝺ	Turned letter, i. e. upside down.
⅋	Dele; take out.
⊏	Move over.
∧	Caret; insert letters or words.
□	An em quad required.
⊙	Period.
⸗/	Comma.
⊙/	Colon.
⸵/	Semi-colon.
⸲	Apostrophe.
⸲⸲	Quotation marks.
-/	Hyphen.
1-/	One-em dash.
1-/	Two-em dash.
¶	Paragraph.
No ¶	No paragraph.
wf	Wrong font.
stet	Correction made in error; let stand.
tr	Transpose.
≡ Caps	To be set in capital letters.
= sc	To be set in small capitals.
lc	To be set in lower case.
Ital	Ital. To be set in italic.
Rom	Roman. Change italic to lower case.
///	Straighten line.

The two instruments customarily used with which to make corrections are the bodkin and tweezers; the latter are, however, to be used with the utmost care, and even then they are very liable to slip and scratch or break the face of the type. In some offices their use is prohibited. If their use is confined to open matter allowing a good grip, such as advertisements, they can be employed to good advantage, but the utmost care must be taken when using them. The bodkin is used to lift up letters, words or lines, so that changes can be made with the fingers. In substituting letters, see that the changes do not alter the justification; if it does, the spacing must be changed. When changes require a new arrangement of the line or lines it is best to lift into the composing stick, justifying being more easily and quickly done. When all corrections have been made, a *revised* proof is taken which should be compared with the first to ascertain that all corrections have been made, and made correctly, and that no errors still exist which were not discovered in the first reading.

For the rules for punctuation and spelling, consult any standard book on language and the dictionary. In this connection it may be stated that the prevailing practice is to use as few marks as will permit of a correct understanding of the matter. In advertisements the style in some offices is to omit marks at the ends of lines. A study of the popular magazines will show this clearly.

PROOF SHOWING CORRECTIONS.

Hints that are worth looking over.

A REPUTATION for promptness is one of the things that a job printer should strive for. He will have gained a great a great advantage when it come to be said of him that he get work always out on time, and it will pay him to endeavor to secure such a reputation by every means in his power. I know how prone is the ordinary business man to wait until he is entirely out of stationary, or whatever he wants, before ordering more, or to postpone until the *latest possible moment* the order for circulars, or hand bills or any bit of commercial work; and then, when he does give you the order, he acts very much as though he though this was the only work you had in your shop, that you should immediately give him precedence over everybody else. If your office is run systematically, you can tell after a moment's reflection just how the work is gettin on, and what chances there are for getting a new job started in. Then you can tell your customer when he can have his work, withi an hour or two, unless it is a job of considerable magnitude. Then if he says that is too late, tell him you are sorry, but you would rather lose the order than disappoint him in the delivery of it. Explain the situation to him, and it is ten cha nces to one he will leave the order.

CORRECTED PROOF.

HINTS WORTH LOOKING OVER.

A reputation for promptness is one of the things that a job printer should strive for. He will have gained a great advantage when it comes to be said of him that he always gets work out on time, and it will pay him to endeavor to secure such a reputation by every means in his power. I know how prone is the ordinary business man to wait unitl he is entirely out of stationary, or whateaer he wants, before ordering more, or ct postpone until the latest possible moment the order for circulars, or handbills or any bit of commercial work; and then, when he does give you the order, he acts very much as though he though this was the only work you had in your shop, that you should immediately give him precedence over everybody else.

If your office is run systematically, you can tell after a moment's reflection just how the work is getting on, and what chances there are for getting a new job started in. Then you can tell your customer when he can have his work, within an hour or two, unless it is a job of considerable magnitude. Then, if he says that is too late, tell him you are sorry, but you would rather lose the order than disappoint him in the delivery of it. Explain the situation to him, and it is ten chances to one he will leave the order.

HOW TO BUILD A SAIL-BOAT.

CARL H. CLARK.

IV. Fitting the Deck and Cabin.

Fitting the step for the mast will be the next thing to do, as it is more easily done now than after the deck is laid. This step is a piece of oak, or other hard wood, about 5″ wide and 4″ thick, and long enough to cover the distance from the stem to the centreboard logs. Its forward end is cut to fit over the end of the stem, and the after end should be fitted down between the centreboard logs. Notches are cut in it for the floors, and it fits down solidly on the keel. It probably cannot be bolted now as the foundation is in the way. The holes should, however, be bored and the bolts driven later. The bolt at the forward end passes through the end of the stem.

The clamp streak is next to be fitted. It is about 2 ½″ x 2″ amidships, and is tapered at the ends to about 2″ x 2″. It runs from the inside of the stem to the sternboard, being riveted to the frames 1 ½″ down from the top, to allow the deck beam to rest upon it. It should be fastened with ¼″ or 5-16″ rivets driven from the outside, with the head countersunk and headed over a washer on the inside. Where these clamps come together at the stem they should be joined together, and a three cornered piece worked on top of them and riveted through; the top of this piece should be flush with the top strake so that the deck plank will lie upon it. See Figs. 13 and 14.

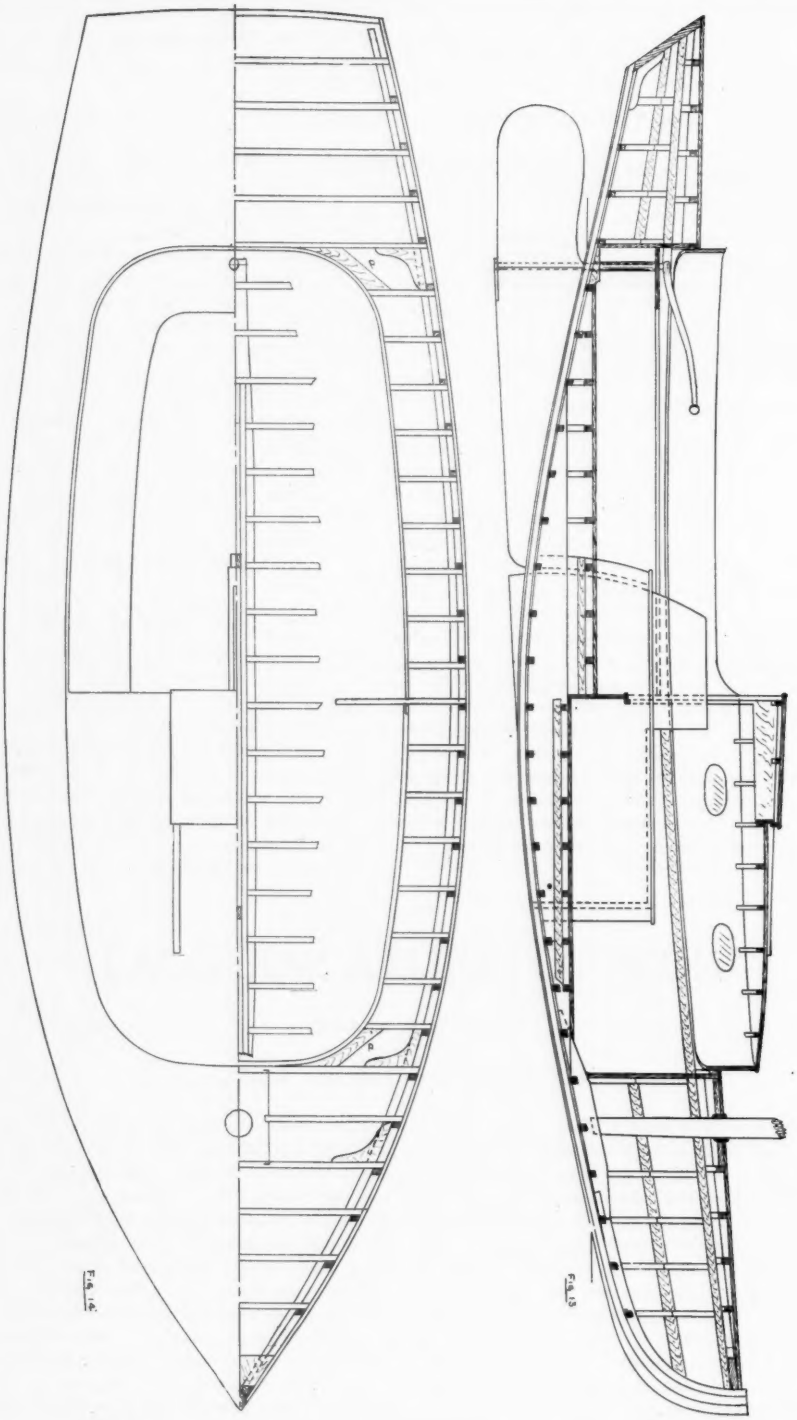


Fig. 16.

Fig. 13.

At the sternboard a knee or corner brace should be shaped to fasten it securely. At the same time a knee should be fitted to fasten the bilge stringer to the sternboard. The plan, as shown, includes a small cabin large enough for two persons to sleep in. It is not, however, necessary that this cabin should be built, as if desired, it may be omitted, and the coaming carried around forward and the boat left open. If the latter method is adopted, the forward end of the standing room should be just at the end of the centreboard casing. The forward upright should be left long and be fastened to the deck above as a support both to it and to the deck. The coaming should be figured to fasten on the after side of this upright.

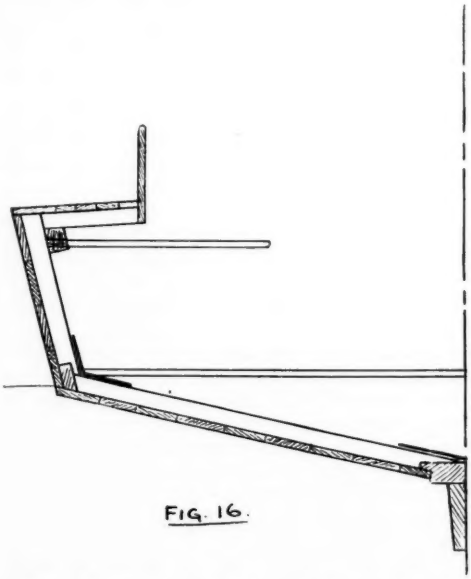


FIG. 16.

The consideration of this point is necessary at this time, as the deck beams are the next thing to be put into place and the cabin calls for a different arrangement than if without it. With a cabin the work is as follows;—The deck beams are 1 ¾″ x 1 ¼″ and are tapered at the ends to 1 ½″ x 1 ¼″. They are cut with a "camber" or round up of 4″ in 7 ½′. All the beams are cut to the same curvatures and the under side is tapered off towards the ends. The beams forward, are laid against the after side of the frame, and those aft are laid against the forward side of the frame, resting upon the clampstrake.

The beam at the forward and after ends of the house and the one at the after end of the standing room are 2″ x 2″. The beams rest upon the clamp strake, which is beveled off, if necessary, to give them a good bearing. They are then riveted or bolted to it with ¼″ rivets. It is also advised that a large nail or a rivet be driven through the end of the beam and the end of the frame. This is not customary, but is considered advisable as making a rather stronger piece of work. The partial beams along the cabin and standing room may have their inner ends supported temporarily by a ribband placed along under them and shored up from below until the deck is laid and they are self supporting. The heavy beam at the after end of the house should extend across the boat, and be cut out later to allow access to the cabin. The three heavy beams at the forward and aft ends of house, and the after end of standing room, are to be placed ½″ away from the frame, a small piece of ½″ stock being placed between them and the frame.

The beam which is cut by the mast is mortised into a piece of 1 ¼″ plank running from beam to beam, as

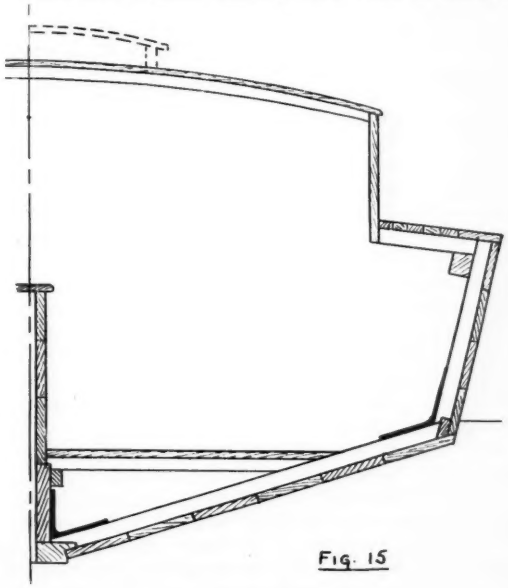


FIG. 15

shown in Fig. 14. This plank is 8″ wide and has its ends halved to fit corresponding rabbets formed in the beams. These rabbets must not be very deep as they take away from the strength of the beam. The plank is to be fastened to the beams by rivets or screws. This plank also helps to support the mast and needs, therefore, to be well fastened. For cutting these beams a pattern can be laid out and used for all, regardless of their length. The curvature is supposed to be the arc of a circle, but by careful work, a batten can be bent to give the curve sufficient accuracy.

There are three deck knees on each side, worked as shown in Fig. 14. They are placed against the beam and on top of the clamp strake and fastened with rivets. A piece of wood should also be placed between them, and the side planking, and a couple of rivets put through. The office of these knees is to strengthen the deck structure, and prevent the boat from twisting or wringing. Before laying the deck the bulkheads

at the forward end of the cabin, and the after end of the standing room, should be set up, as it is much easier to do it now than later. The partitions are of ½″ matched stock. There should be just space for each board to fasten to the after side of the frame at the bottom, and to the forward side of the beam at the top. The several boards should be nicely fitted to the outline of the frame, and strongly nailed, as these bulkheads are a very valuable stiffener to the boat and help to keep her in shape. An opening should be left in each, to be fitted later with a door.

The deck is ¾″ thick. It may be either covered with canvas, or left bright and varnished as preferred; the former is most easily kept in order, but the latter adds greatly to the appearance, although it requires some attention to keep in good condition. The description of the canvassed deck will first be given. The planking should start at the middle, where a single wide board should be used. It should be about 12″ wide and ⅞″ thick, as it has to be cut for the mast hole. Tongued and grooved stock of pine is to be recommended for the remainder of the decking. It is laid with the beaded side down, to leave a smooth upper surface, as any ridges are likely to cause wear of the canvas. Small headed nails are used to fasten the decking, and they are driven or set below the surface. At the edges the decking is finished off to the curve of the sheer strake and strongly nailed to its edge. The decking must make as good a joint as possible with the top strake, as any leak here will show when she heels over under sail. At the stern, also, the plank is trimmed off even with its after surface. The stock for the deck should in any case be thoroughly dry and well seasoned.

If the deck is to be finished bright, an oak board 9″ wide, and ¾″ thick is first laid down the middle of the deck forward, joined to the stem and fastened to the triangular pieces of plank forward and to each beam. All the deck fastenings in this case must be counterbored for and afterwards plugged with wooden bungs. The plankshears, or covering boards, are 3″ wide, and ¾″ thick, and are bent around the outside of the deck and fastened to each beam and to the edge of the top strake. At the bow a miter joint is made with the middle plank, as shown in Fig. 14. These boards will require steaming. A piece 3 ½″ wide is also fitted across the stern making a miter joint with the covering board. To support the latter piece and also the ends of the plank at the stern, a ledge must be formed of pieces fastened on to the sternboard.

The planks in this case are of white pine ¾″ thick, and are very narrow, about 2″. They are bent around inside the covering board, and fastened to deck beams and the ledges at the ends. Pieces are nailed to the underside of the middle plank between beams to take the ends of the plank. The edges are beveled just slightly near the top surface to allow the insertion of calking, but below, they should be close together. After the deck is laid, the opening for the cabin and standing room should be trimmed out. The clear space of deck around them is 12″ and it is parallel with the outside of the deck. The ends of the short deck beams may be cut off evenly, and the short pieces *a a*, Fig. 14, may be fitted and nailed to beams and deck; these pieces are to strengthen the house at the corners and allow a good fastening. The deck is to be canvassed later, after the coamings are in place.

The cabin trunk is of oak ¾″ thick and 13″ wide. It will probably be necessary to make a joint on the forward end which should be done by halving the two pieces. The fitting and bending of this trunk is a rather fussy piece of work. A form should be made to bend it over, and it should be thoroughly steamed before bending is attempted. It will be well to bend the two pieces for the trunk some time before they are wanted so that they may have time to become thoroughly set into shape, and bring no strain upon the boat by any tendency to open out. They may then be used as a pattern by which to cut out the deck and thus make the fitting easier.

The lower edge of the trunk is to be even with the lower edge of the deck beams. At the after end it extends even with the after face of the heavy beam, being notched to fit around it. It is fastened to the end of each beam with a long screw, and also to the edge of the deck plank near each beam and once between beams. The sides of the trunk should not be perfectly vertical, but should slope inward slightly. The joint on the forward end is a halved joint fastened with copper rivets.

The port lights in the trunk are not to be cut until later, after everything has set into place. The stock for trunk must not be too well seasoned, as it is then somewhat brittle and apt to break when bent to a sharp curve. As soon as the water from steaming has evaporated, it should be given a heavy coat of oil, and when this has soaked in a coat of shellac both inside and out to keep the air out and prevent checking. The wash rail or coaming should next be bent into place. This will be much easier to fit than the trunk sides. It is of oak ⅝″ thick and 9″ wide. Where it meets the trunk, the end should be cut down to about 9-16″ thick and allowed to lap on to the outside of the trunk, the latter being cut out for this purpose. It is fastened with brass screws. The joint between the pieces forming this coaming may be either at the after end, using two pieces, or on the sides, using two short pieces and one long one. This latter is to be preferred, as the joints can be covered on the outside with a block which is convenient to take a rowlock socket later. The upper edge is rounded and it is treated with oil and shellac as with the trunk.

All the fastenings in the coaming and trunk should be counterbored and afterwards plugged with bungs so that they may be finished bright if desired. In order to give the forward end of the coaming the curve up to the height of the house side, as shown in Fig. 13 and Fig. 1, a curved piece is cut and fitted on the top

of it, and fastened to the house side in the same manner as the coaming. The beams for the top of the cabin house are 1 ½″ x ¾″ oak, and are cut with a round up of 5″ in the width of the house. The after face of the aftermost beam should be directly over the after face of the strong beam below. The beams should be spaced about 8″ on centres. If a beading tool is at hand, a bead can be cut on the lower edges of each beam, giving a little finish. The ends of the beams are dove-tailed and fitted into a corresponding dove-tail in the trunk side. The dove-tail should not come through so as to show from the outside. A nail may also be driven in the end of each beam.

The top is of ½″ tongued and grooved sheathing, laid smooth side up and nailed to the beams and the trunk side. Its edge is smoothed off even with the side of the trunk. Before undertaking to cover the deck and housetop with canvas, all ridges and sharp points should be trimmed. The top of the house and the deck may now be covered with canvas, heavy drill or light duck being suitable for this purpose. It can usually be obtained in almost any width, thus avoiding seams, which soon wear out. The piece for the house top is in a single width, while that for the deck is in two pieces, each covering a side and lapping on to the centre plank, which is not covered. The edge of the centre plank is beveled off to the level of the adjacent plank, or still better, cut out square for a distance of about ⅝″ or ¾″ back to take the edge of the canvas. The opening for the house and cockpit is first cut approximately to shape.

The forward end of the deck is smeared with thick lead paint, and the selvage edge of the canvas is tacked along in the depression or rabbet which was cut in the middle plank. The tacks used should be of copper driven about ¾″ apart, and the canvas should be drawn tight. After tacking the middle seam the canvas is drawn tightly over the edge of the deck, and a row of tacks driven around the edge. When the trunk is reached the canvas should be trimmed out and fitted carefully around it, a row of tacks driven as close to it as possible, and a flap an inch or so wide allowed to remain. This is continued all the way aft taking care to draw the cloth tightly and keep out all wrinkles. The deck is of course heavily coated with the paint before laying the canvas. On the after deck it is treated the same as on the forward deck. A strip of oak 1 ¼″ x ⅝″ is now fastened over the outer edge of the canvas about ½″ back from the edge of the deck, and the canvas is trimmed off even with its outside edge. This gives a finish and also keeps the edge of the canvas tight.

A quarter round moulding is also fitted against the cabin trunk and coaming. The corner under the canvas should be well filled with paint and the moulding fastened tightly against the house to keep out rain and spray. The top of the cabin is covered in the same manner, the canvas being turned down over the edge and tacked. A ¾″ oak half round moulding is bent around the house and across the after end, and the canvas trimmed off to it. The centreboard box can now be completed. It is of ⅞″ well seasoned stock, and is fastened with light rivets. The uprights, and the inside of the boards are given a thick coat of paint, and a thread of cotton is laid against the sides of the uprights before putting the boards in place. The boards should be rather narrow and each one should have several ¼″ rods extending down through it into the one below to strengthen the whole. The top should be about 12″ above the waterline. The uprights should now be cut off even with the sides, except where no cabin is fitted and the forward one extends to the deck.

A MODEL STEAMBOAT. Cont'd.

and running from the valve on the boiler to the steam inlet on the engine or turbine.

The means for feeding the boiler next requires attention. A small pump is to be used, run by a belt from the shaft of the engine. This means is suggested, as the adjustment of the pump to give the correct amount of feed must be done by trial, and by varying the sizes of the pulleys driving the pump. After it is once adjusted it will be nearly automatic for all speeds of the engine. This feed pump draws from a tank which is placed in some convenient part of the boat and discharges into the boiler through the feed pipe before mentioned. The pump must be so adjusted as to maintain the water level at the point marked, and neither flood the boiler, nor allow it to run dry, as the latter is a source of great danger. The tank should be of fairly large capacity, as the steam is thrown away after passing through the engine. The pipes for the feed pump can be about ⅛″ diameter.

For the burner, a rather large alcohol lamp is needed. There are several ways of making these, but the simplest is as follows. A sort of pan is made about 4″ long, 2 ¼″ wide and ⅝″ deep with flaring sides. It rests in the furnace just below the centre with short legs to keep it away from the furnace side and admit air around it. From this pan a ⅛″ pipe leads to the reservoir of alcohol several inches away. This pipe has a cock or valve in it to regulate the supply of alcohol. The pan is now filled nearly full of asbestos wool, and a piece of wire gauge is set on top to keep it in place. A shield is to be arranged to cover the mouth of the furnace and prevent the flame coming out. Air must however, be freely admitted both above and below the lamp. If the burner smokes it shows that too much alcohol is being used for the amount of air present.

It will probably be found that on first starting up the boiler the draft will be poor and some means must be taken to accelerate it, either by passing or exposing to a brisk wind, but after the boiler and stack become warm, no trouble should be found. The exhaust from the engine may be carried into the stack and made to assist the draft. If desired, a whistle and other accessories may be fitted.

JUNIOR DEPARTMENT

For the Instruction and Information of Younger Readers.

ELEMENTARY MECHANICS.

J. A. COOLIDGE.

III. The Inclined Plane.

We will next study the construction, uses, and advantages of the inclined plane. Next to the lever this is the simplest of the mechanical powers, and a machine that we can hardly fail to see in walking five minutes about the business portion of a large city.

The board used in our experiments in friction can be used once more. It should be a piece of clear pine board, 3′ long, 6″ wide, and ¾″ thick. We must cut a piece ¾″ wide and 2 ½′ long out of the middle of the board. See Fig. 6. Next we must have two strips of wood, ⅝″ thick, 24″ long, and 3″ wide, with a slot ⅜″ wide cut out of the middle to within 1 ½″ of each end. See Fig. 7. These will serve as supports for the upper end of

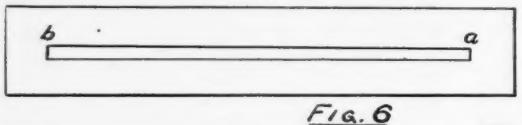


FIG. 6

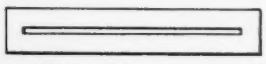


FIG. 7

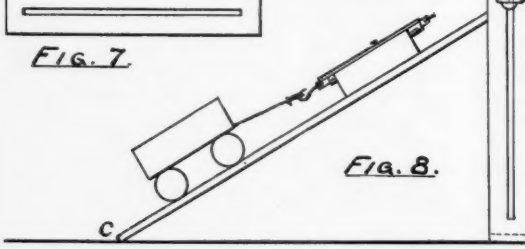
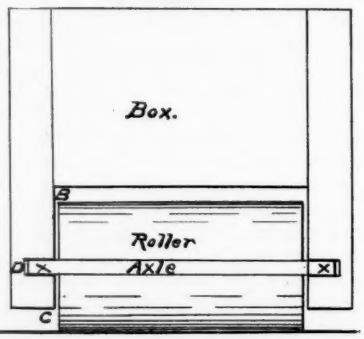


FIG. 8.

FIG. 9.



two pieces of curtain pole or other round stick at least 1 ½″ in diameter, 2 ⅞″ long, and polish as smooth as possible. Through the length of these pieces, exactly in the centre, bore a hole ¼″ in diameter. Or large spools may be used by carefully cutting off the bevel ends, only they must be smoothly rounded. Two pieces of ¼″ brass rod, which can be got with the curtain pole of any furniture dealer, must be cut 3 ⅝″ long. These may be made to serve as axles for the rollers by dropping a little shellac into the holes of the wooden rollers and then pushing the rods through. See Fig. 9. Two narrow pieces ⅝″ thick, 5″ long and 3 ½″ wide will next be needed; ¾″ from each end, and ½″ from one edge, bore our board *A*, and should be fastened by two screw-eyes *S*, that fit into *A* and are prevented from pulling through the slots by tightly fitting washers. See Fig. 8. The lower end of the strips may be kept in place at *b*, by nailing them to a strip of wood 6″ long and 3″ wide.

Now we must make a little car which shall run with very little friction, a well made toy railway car will answer. With these appliances our experiments ought to be accurate enough to teach us the laws of the inclined plane. A small wooden box 5″ x 3″ and 2″ deep should be made of ⅜″ stock and mounted on two rollers as wheels. Cut holes $\frac{5}{16}$″ diameter and ⅜″ deep. See *D*, Fig. 9. These holes must be made as smooth as possible and lubricated with powdered graphite. Our axles, *X X*, Fig. 9, will fit easily in these holes and should turn with but little friction. After fitting these in the holes, tack or glue the strips to the sides of the box and we have a car which, though crude, will serve our purpose very nearly as well as a more expensive one.

Before studying the laws of the inclined plane, one or two experiments in friction must be performed, and in all experiments allowance should be made for the force lost in overcoming the

		Total Wt.	Total Force	Friction	F less Friction	P x L	Wt. x H
a b	12 in.	2 lbs.	"	"	"	"	"
	"	3 lbs.	"	"	"	"	"
	"	4 lbs.	"	"	"	"	"
a b	18 in.	2 lbs.	"	"	"	"	"
	"	3 lbs.	"	"	"	"	"
	"	4 lbs.	"	"	"	"	"
a b	24 in.	2 lbs.	"	"	"	"	"
	"	3 lbs.	"	"	"	"	"
	"	4 lbs.	"	"	"	"	"

friction, and not directly available in moving the weight we wish to raise.

EXPERIMENT XI.

Take the block used in the experiments in friction, draw it along the board five or six times. Divide the force used to move the block by the weight of the block. This, as you know, is the co-efficient of friction. Raise the end of the board *A C*, Fig. 8; place the block on the board and adjust the height *a*, until the block will just slide down with uniform speed. Great care must be taken that the block does not move with increasing speed. Measure carefully the height *a b* and call it *h*; also the base *a c* and call it *b*. Divide *h* by *b* and the quotient, *h* divided by *b*, is the coefficient of friction and should be the same as that found before, although found in a different way. Let us suppose this is about $\frac{2}{10}$ Whatever it is, that fractional part of the force used should be deducted on all experiments with the block, on account of friction, the remainder is available in moving the body.

EXPERIMENT XII.

Place upon the block weights enough to make the entire weight 30 ounces, and pull it up the board *a c* several times until we have determined accurately the average force employed in moving it. Deduct the force used in overcoming friction, and we have *W*, the weight, and *F*, the force. Measure the height *a b* and the slant *a c*. See Fig. 8. Multiply *F* by length *a c*. Multiply *W* by height *a b*. Do they agree? They should. By the law of the inclined place, "Power x Length = Weight x Height." Make the height *a b* less than before and try the experiment again.

EXPERIMENT XIII.

With the board horizontal find the friction in pulling the little car with a total load, car and weights, of 2 lbs. Raise the end of the board *a* 12″ above *b* and try again. Increase *a b* to 18″ and then as high as possible, in each case determining the force, after deductiug the friction. It is very easy to see in a general way that the steeper the slant the greater the force. We will now try the experiment more systematically, and arrange our results so that we can see what the experiment teaches.

Does the law $P \times L = W \times H$ hold true?

Can you not, as you compare the force and weight, see how barrels are rolled up inclined planes? Think of the skids and planks on all the trucks. Every large team carrying barrels and bales of merchandise has one hanging on one side or underneath. But why is this possible? After taking out friction, which must be overcome in moving the car even over a horizontal surface, we find 1 lb. force moving 3 lbs. weight. In considering the object to be attained we find that it is to lift a weight the distance *a b*, or a barrel of sugar into a wagon, let us say. The weight has to be slid or rolled the length *a c*, or up an incline three or four times as long.

The weight lifted may be considered as a force acting against the moving force, and it may be separated into two forces, or two results. One effect of the weight is to bend the inclined plane, as can be seen when a very heavy weight is resting on a plank. This effect, or force, is overcome or met by the stiffness of the plane. The other effect of the weight is to roll or slide down the plane. The force that is used in moving the weight up the plane overcomes this force. The nearer horizontal the plane is, the nearer the the force necessary to move the weight is to zero. The force is always as many times less than the weight as the height is times less than the length.

EXPERIMENT XIV.

It now remains to move the car with a force parallel to the base *b c*. Fasten the car to the hook of the balance by a long thread, pass the thread through the slot in the board and pull the loaded car up the incline *a c*, keeping the string and balance always horizontal. At first this will be awkward, but after a few trials we can obtain a satisfactory result. Measure *a b* and *b c*. Try $F \times b\ c$ and $W \times a\ b$. How do these products agree? We should find the results correspond as before, but the reason is not so easily seen. Perhaps it will be enough to know that it is true. Questions of horces pulling wagons up a hill, or loaded cars up a track can now be answered. In all cases the gain in moving a large weight with a small force is offset by the necessity of making the force act through a correspondingly greater distance.

ELECTRICITY BY EXPERIMENT.

II. Magntic Field.

The space surrounding a magnet over which the magnetic forces extend is known as the *magnetic field*. It is desirable to learn fully the direction and form taken by these magnetic lines of force, which we can easily do with the two bar magnets and iron filings nsed in the previous experiments. A sheet of thin, firm writing paper is glued to a wooden frame, made of strips of wood ½″ thick. The frame keeps the paper firmly stretched and free from wrinkles,

EXPERIMENT 6.

Place the frame over a bar magnet, the latter just touching the under side of the paper. Sift the iron filings over paper, at the same time lightly tapping the frame with a small weight. The filings will be seen to arrange themselves in certain curves, thus producing a graphic illustration of the magnetic lines of force, or magnetic field surrounding the magnet.

EXPERIMENT 7.

Place the second bar magnet parallel with the other, and about 1 ½″ from it, with the N pole of one magnet at the same end as the S pole of the other magnet. Again sprinkle the iron filings on the paper as before, and study the curves formed by the filings. Place the two N poles at the same end, and study the curves formed by the filings.

These experiments are important and should be made carefully and a sufficient number of times to firmly fix in the mind of the student, the action of the magnetic field under the several conditions of polarity above mentioned. A photographic record can be made by using a developing paper, arranging the filings by light from a ruby lantern and then exposing to white light and developing.

Another way is to use wax coated paper, upon which the filings are arranged, then heating the wax with a lamp held underneath at a proper distance to soften the wax sufficiently to allow the filings to embed themselves therein; the wax quickly hardens upon withdrawing the lamp, firmly fixing the filings in position. Care must be taken not to ignite the wax or heat it to the extent that it will melt and drop into the lamp. Another way is to use gumed paper. When the filings are arranged, moisten the paper with spray from a vaporizer, then dry quickly over a stone.

HOW BOYS CAN EARN MONEY.

I. FLOWER SEEDS AND FERTILIZERS.

A good business to be carried on with a small capital is that of selling flower and garden seeds and fertilizers. This business, although it can only be carried on in the spring, gives good profits while it lasts. First write to the nearest wholesale seed dealers who have a good standing for reliable goods. Tell the dealers what you propose to do, and ask for cat alogues and what discounts from the catalogue prices prices they will make to you. Then get a supply of catalogues from the dealer you decide to order from. Next call on your proposed customers and leave catalogues with those who promised to give you orders. State when you will call for the orders and catalogues, and then distribute the catalogues with others. As the season is so short, visit as many people as possible as soon as you can. When you have a sufficient number of orders from customers. make out an order and send to the dealer. Have your orders on the dealer as large as possible, so not to pay express charges on too many lots. It convenient, tomato plants may be sold with good profit. The success of this business will depend upon selling seeds that have a known reputation for being reliable.

BOOKS RECEIVED. Cont'd.

LABORATORY PHPSICS. Dayton Clarence Miller. Cloth. 404 pp., 8 ¼ x 5 ¾, $2.00 Ginn & Co., Boston.

This is essentially a laboratory manual, in which one hundred and twenty eight well selected exercises are fully and carefully presented. The grade of work is that of the usual undergraduate course in colleges and technical schools and presupposes that the laboratory work will be accompanied by a course of lectures and recitations in general physics. As far as possible the descriptions are independent of any particular form of apparatus, thus making it available with laboratories of varying equipment. The details of manipulation are adequate, and the the explanations of the generals principles and scientific meaning of the experiments clearly presented. Thirty three tables and 182 illustrations.

OUT DOOR PORTRAITURE. Mathilde Neil, No. 58 Photo-Miniature.

COMBINATION PRINTING. A. Horsly Hinton. No. 59, Photo-Miniature. 25 cents. each, Tennant& Ward, New York.

No one can have been engaged in photographic work for any length of time without learning of the Photo-miniature series. In a form convenient for carrying in the pocket, each number contains a well written presentation of some special feature of photographic work, as well as numerous notes likely to be of interest. This enables the reader to study such branches of work as he may desire without being encumbered with a large book containing much of no interest. The two numbers above mentioned are of particular value, the first to all photographers, and the second to those who have acquired a reasonable degree of manipulating skill.

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